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INTRA-ANNUAL AND INTER-ANNUAL RAINFALL VARIABILITY
OVER EAST ASIA, SOUTHEAST ASIA, AND SOUTH ASIA

by

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INTRA-ANNUAL AND INTER-ANNUAL RAINFALL VARIABILITY OVER EAST ASIA, SOUTHEAST ASIA, AND SOUTH ASIA

Yang Guangji Liu Jiaming /304*

ABSTRACT

This article applied average monthly precipitation data for April - September 1951-1981 and average ten-day data for April - September 1961-1970. It did research on interannual and intraannual changes in precipitation for East Asia, South Asia, and Southeast Asia. It analyzed precipitation differences between eastern and western China as well as the characteristics of Yangtze valley drought and excessive rain. Results point out that there is a constant trend shown in a southwest-northeast direction in association with distributions of areas of large rainfall above 200mm from April to September in East Asia, South Asia, and Southeast Asia. It is closely in line with the direction of movement associated with southwest monsoons. In this belt of heavy rains, three different types of precipitation are included. Besides this, amounts of 10 day precipitation in China's Yangtze-Huai area from July to September harbor quasi periodic oscillation phenomena associated with periods of approximately 20 days. They are completely different from precipitation distributions associated with western China. Precipitation in south and central China has an inverse relationship to El Nino phenomena. Statistical results clearly show that there is only a 23% probability of producing sustained heavy rain and sustained scarce rain on the middle and lower reaches of the Yangtze River in summer. Most years have normal precipitation. Finally, we also discussed circulation factors influencing drought and excessive rain on the middle and lower reaches of the Yangtze River in summer.

I. INTRODUCTION

Areas such as India, China, and Japan occupy together the Asian monsoon zone. From April to September, the surplus or scarcity of precipitation in these areas as well as its distribution are not only influenced by intraannual monsoon changes. Moreover, it is also influenced by such interannual changes as the earliness or lateness of the advent of monsoons,

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* Numbers in margins indicate foreign pagination. Commas in numbers indicate decimals.

their strength or weakness, and so on [1-6]. In particular, when atmospheric circulation produces relatively large interannual changes, these often give rise to certain irregularities associated with regional precipitation, creating floods and waterlogging or drought.

Of course, the location and strength of precipitation belts are not only related to atmospheric circulation backgrounds. They are also related, moreover, to such factors as terrain. For instance, speaking only in terms of factors influencing South Asian and Southeast Asian precipitation, there are also relationships to the influences of such conditions as air mass temperature structures, the dynamic structure of air flow disturbances, as well as terrain, and so on [7].

As far as studies of interannual and intraannual precipitation changes are concerned, they are not only advantageous for a deeper grasp of climatic distribution characteristics associated with precipitation in these areas but for the relationships with atmospheric circulation. At the same time, they are also helpful to research associated with medium and long term precipitation forecasts.

This article uses 30 years of average monthly precipitation data for April to June and 10 years of average 10 day precipitation data from April to June as well as such data as 10 years of monthly average wind fields and so on in studies of intrannual changes and interannual changes associated with precipitation in such areas as East Asia, South Asia, and Southeast Asia, precipitation characteristics of East and West China as well as Yangtze valley flood waterlogging and drought in summer.

II. EAST ASIA, SOUTH ASIA, AND SOUTHEAST ASIA MONTHLY AVERAGE PRECIPITATION CHARACTERISTICS

Fig.1 is a diagram of monthly average amounts of precipitation in East Asia, South Asia, and Southeast Asia from

April to September over 30 years. In the diagram, the numbers 2, 1, and 0, respectively, stand for total amounts of monthly precipitation greater than 200mm, 100-200mm, and smaller than 100mm. Here, we stress research on the distribution characteristics of heavy rainfall areas with more than 200mm/month. From Fig.1 it is possible to see that: /305

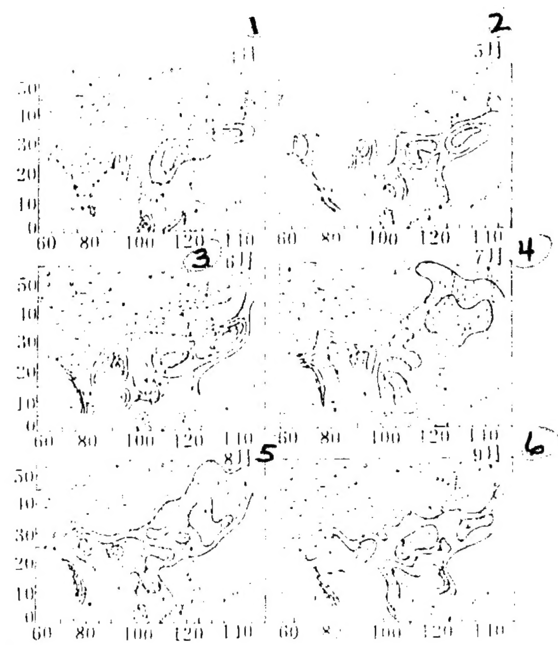

Fig.1 Chart of Average Monthly Amounts of Precipitation from April to September in East Asian, South Asian, and Southeast Asian Areas

Key: (1) April (2) May (3) June (4) July (5) August (6) September

1. Climatic Characteristics Associated with East Asian Average Monthly Precipitation In April, the scope of precipitation above 200mm is not large. There are only two areas of heavy rainfall associated with small ranges in eastern China and southern Japan. However, from April to June, the scope of the two areas of rain gradually enlarges. In June, they develop to become a rain belt associated with a northeast-southwest direction. Its center is in southern Japan. The amounts reach 400mm/month. This is nothing else than the famous East Asian Meiyu (plum rain) belt.

From July to September, this rain belt again splits into two parts. One part moves east to northeastern China and the area of Japan. The other part moves to southwestern China. At the same time, the scope of the rain areas contracts month by month.

2. Precipitation Characteristics of South Asia and Southeast Asia In April, precipitation areas of 200mm or more only exist in the vicinity of 25°N, 90°E. The ranges are very small. From May to August, ranges enlarge month by month. In September, the scope of areas of heavy rainfall again shrink to northeast India as far as the northern Bay of Bengal. What is worth paying attention to is that, from April to September, the area in the vicinity of 25°N, 90°E is a core zone of heavy rainfall from beginning to end.

In the Southeast Asian area, from April to June, zones of heavy rainfall above 200mm exist in the vicinity of the Malay peninsula, Sumatra, and Kalimantan island. From July to September, heavy rainfall zones expand northward to the area of the Philippines. Moreover, the strength of heavy rainfall areas increases. In the area of Zengmu Reef, heavy rain reaches 900mm/month. At the same time, we also see that the appearance of Southeast Asian areas of heavy rain is earlier than the Indian peninsula.

3. Precipitation Characteristics of the Western Coast of India In April, when the southwest monsoon has still not

arrived, monthly average amounts of precipitation associated with the Indian peninsula are basically below 100mm. However, from May to September, the west coast of India forms a sustained belt of heavy rain above 200mm running north south. Its formation is related to the southwest monsoon climbing over the high western blocking mountains of the Indian west coast [6].

Through the analysis above, we see that, from April to September, distributions of heavy rain belts above 200mm always have a tendency to take a southwest-northeast direction. It is closely in line with the direction of the southwest monsoon. However, in this continental wet belt, there are roughly three different types of precipitation, that is, the East Asian zones of heavy rainfall [8-10] closely related, primarily, to the seasonal development of East Asian circulation; zones of heavy rainfall along the sea from the Bay of Bengal to the southeast, receiving relatively large influences from tropical convergence belts and terrain; as well as zones of heavy rainfall associated with the Indian west coast and primarily related to southwest monsoon system and terrain influences.

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III. EAST AND WEST CHINA TEN DAY PRECIPITATION AMOUNT CHARACTERISTICS

Fig.2 is an average ten day precipitation amount diagram from the first ten days of April to the third ten days of September for 10 years in eastern China. The range of the diagram in question is 100-120°E, 22.5-47.5°N. It is a time-latitude cross section diagram created with ten day precipitation amount average values associated with precipitation stations in each 5 latitude belt within the range in question.

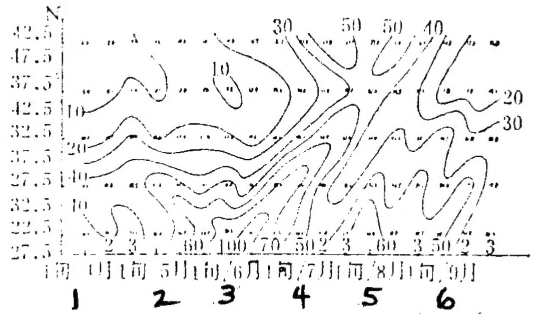

Fig.2 Time-Latitude Cross Section Diagram for East China 10 Day Precipitation Amounts from April to September (Unit: mm)

Key: (1) 1st Ten Days/April (2) 1st Ten Days/May (3) 1st Ten Days/June (4) 1st Ten Days/July (5) 1st Ten Days/August (6) 1st Ten Days/September

From Fig.2 it is seen that, beginning with the second ten days of May, heavy rain belts of more than 50mm/10 days have moved from south to north. Between the third ten days of July and the first ten days of August heavy rain belts arrive in the southern part of the North China area. In conjunction with this, splitting phenomena appear in association with the rain belts. After that, zones of heavy rain jump to the northeast area. Movements of areas of heavy rain from the south and north are mutually related to weakening north of the West Pacific subtropical high pressure as well as of the high altitude westerly jet stream. This can be clearly seen from latitude-altitude cross section diagrams (Fig. omitted) associated with east west wind components at 115°E.

Besides this, in Fig.2, we can also see that there exist oscillation phenomena in ten day precipitation amounts following belts of heavy rainfall. Looking, then, at the 10 day average diagram, the rough period of the oscillation is approximately 20 days. Moreover, the clear oscillation area is in the zone 30-

35°N. This is exactly China's Yangtze-Huai valley and the surrounding area.

Fig.3 is a ten day precipitation amount time-latitude cross section diagram through western China and the Tibet plateau. Station 55591 (Lhasa) and station 51777 (Ruoqiang) are located, respectively, on the north slope and the south slope of the plateau. Precipitation associated with the two stations can represent the precipitation characteristics of the north and south areas associated with the Qinghai-Tibet plateau. Fig.3 clearly shows that Lhasa station ten day precipitation amounts are relatively small before May. Beginning in the second ten days of June, precipitation amounts gradually increase. In the first ten days of August, rainfall amounts reach maximum. They increase from 23.3mm/ten days to 62.3mm/ten days. After the first ten days of August, amounts of precipitation again gradually diminish. By the third ten days of September, precipitation amounts decrease to 6.1mm/ten days. However, precipitation amounts for stations on the north slope of the plateau are unusually small right through from April to September--in all cases, less than 3mm/ten days. Station 51463 (Urumqi) and station 51076 (Altai) are located in northwest China. Their precipitation is capable of representing northwest China's precipitation characteristics. From April to September, their ten day precipitation amounts are generally from a few mm to 10-20mm.

Looking at the analysis above, the precipitation characteristics of eastern and western China are completely different. In particular, precipitation distributions in the west are relatively complicated. Summer precipitation on the south slope of the plateau is unusually plentiful. Rain on the north side of the plateau is scarce right along. Moreover, precipitation associated with the northwest area lies between the two discussed above.

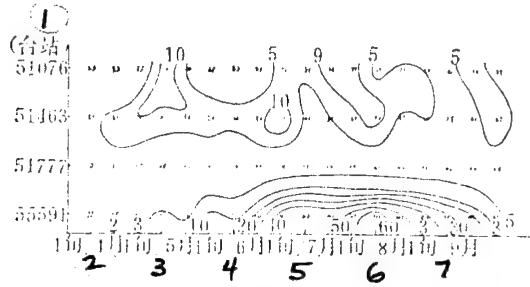

Fig.3 Time-Latitude Cross Section Diagram for Ten Day Amounts of Precipitation in Western China (Crossing the Qinghai-Tibet Plateau) (Unit: mm)

Key: (1) Station (2) 1st Ten Days/April (3) 1st Ten Days/May (4) 1st Ten Days/June (5) 1st Ten Days/July (6) 1st Ten Days/August (7) 1st Ten Days/September

Why is the difference in precipitation between the north and south sides of the plateau such a wide gap? Below, we will discuss this question from two sides.

Fig.4 is an average radial vertical circulation diagram from April to September for 10 years at 90°E (diagrams for May, June, and July omitted). In the April-May period, the south side of the plateau is a Hadley circulation form, controlled by air above the plateau and sinking air currents on the south slope. From June to August, following the establishment and strengthening of monsoon circulation forms, the air above the south side of the plateau changes from an area of sinking air flows to an area of rising air flows. By September, monsoon circulation begins to weaken. The air above the south side of the plateau again shows the appearance of an area of sinking air flows.

Right through from April to September, the north slope of the plateau is under the control of air currents sliding downward. Again, from the north to the northwest China area, the general configuration of vertical air flow fields from April to September is high altitudes above 300hPa mostly being rising air flows and below 300hPa mostly being sinking air flows. Therefore, from the characteristics of vertical air flow distribution, it is possible to understand the distribution

states of amounts of precipitation associated with the different areas and different periods of time described above. In general, areas with more rain correspond to areas of rising air flows. The higher the thickness of rising air currents, the greater the amounts of precipitation also are. However, areas of scarce rain correspond to sinking air current zones.

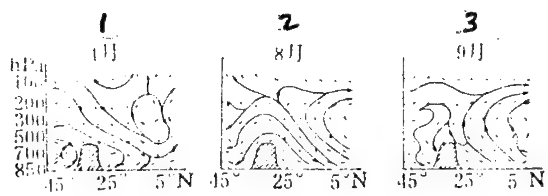

Fig.4 Qinghai-Tibet Plateau Area 90°E April, August, and September Monthly Average Vertical Circulation Cross Section Diagrams

Key: (1) April (2) August (3) September

Besides this, it can be seen from the time-altitude cross section diagram (diagram omitted) associated with radial winds in the area surrounding Lhasa (25°N, 90°E), that, before May, south winds are below 1.5km. South wind strengths are 1 m/s. Beginning in June, the altitudes reached by south winds go up. Strengths also increase. By August, the height exceeds 6km. Core strengths reach 2 m/s. After August, the altitudes reached by south winds again very rapidly drop. Strengths also diminish. It is not difficult to see that the abundance or scarcity of rainfall at high mountain stations on the south side of the plateau is related to the altitudes and strengths reached by the southwest monsoon, because this branch of warm, moist southwest air flow carries with it adequate moisture. As far as plateau north slope and west slope areas are concerned--due to terrain blocking the southwest monsoon--these areas do not get adequate moisture supply.

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IV. RELATIONSHIPS BETWEEN DROUGHT AND EXCESSIVE RAIN IN EASTERN CHINA AND THE EL NINO PHENOMENON

We know that there are many types and kinds of meteorological factors influencing Chinese drought and excessive rain. Moreover, mutual interaction between the sea and air is only one factor among these. What previous research work involves to a relatively great extent is the relationships between it, the Meiyu of the middle and lower reaches of the Yangtze, and North China plain precipitation [11,12]. With regard to the appearance of the El Nino phenomenon, there has been little research done on such questions as what relationship there is between it and South China area precipitation, what differences there are between its influences on South China and Central China precipitation, as well as whether or not there is a relationship between North China precipitation and this phenomenon. This section will discuss this problem.

Here, the South China area uses the five stations of Ganzhou, Youtou, Guangzhou, Nanning, and Haikou to be representatives. The Central China area uses Shanghai, Hankou, Yichang, Nanchang, and Zhijiang to be representatives. The North China area uses Shenyang, Beijing, Zhengzhou, Taiyuan, and Yinchuan to be representatives. Research was done on the precipitation characteristics of months with heavy rain and the whole rainy season from April to September. /308

El Nino years are years adopted for use on the basis of LoLand paire studies of numbers of hurricane days and El Nino phenomenon related times (taken from Weatherwise Aug.1985). From 1900 to 1984, El Nino appeared in a total of 16 years. In the 30 year period from 1951-1980, there were 5 El Nino years, that is, 1953, 1957, 1965, 1972, and 1976.

We applied monthly average precipitation data associated with the 30 years from 1951-1980, searching out average precipitation values for the various individual periods of time and different areas. Following that, we again sought out the

deviations of precipitation values in areas during different time periods each year with respect to the areas average values. Fig.5 was drawn up just on the basis of precipitation deviation values obtained.

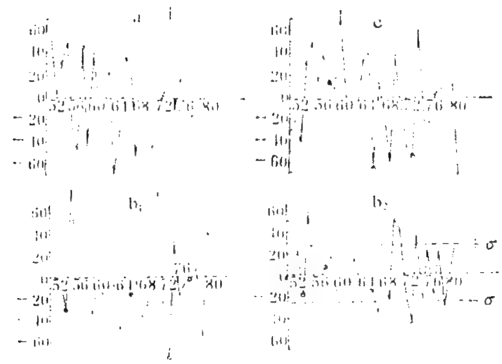

Fig.5 Precipitation Deviation Curve Diagrams For the Period April - September in South China, Central China, and North China Areas (Unit: mm)

Fig.5a is the precipitation deviation curve for the South China area from April - June. In the Fig., the round circle symbols are El Nino years. They clearly show that, no matter whether it is April - June or April - September (diagrams omitted), El Nino years, basically, correspond with positive deviation values associated with precipitation. However, they also do not completely correspond to maximum positive deviation values in precipitation. Correspondence relationships from April to June compare well to April to September.

Fig.5b_1 and b_2 are, respectively, precipitation deviation curve distribution charts for the Central China area from June to July and from April to September. They clearly show that, with respect to the Central China area, El Nino years basically correspond to negative deviation values associated with precipitation. However, they also do not completely correspond to maximum values for negative deviations in precipitation.

Correspondence relationships for June - July are better than for April to September. In reference [11], it points out that, when equatorial East Pacific temperatures go on the high side, the Yangtze-Huai valley is short of rain. This result and our research are consistent.

In the case of the North China area, no matter whether it is July - August (Fig.5c) or April - September (diagram omitted), El Nino years corresponding to years with positive deviation and negative deviation precipitation were not much different. Therefore, the abundance or scarcity of North China area precipitation has no great relationship to the El Nino phenomenon.

Going through the analysis above, one sees that, when El Nino years appear, the South China area easily produces plentiful rain phenomena, and Central China easily produces scarce rain phenomena. The rainy season precipitation and El Nino phenomenon associated with these two areas possess inverse relationships. This statistical result is a help to research on medium and long term precipitation forecasts. However, we should see that a number of years with plentiful rain and scarce rain certainly are not El Nino years. The explanation for this is that the factors influencing eastern China drought and excessive rain are multifaceted, and the El Nino phenomenon is only one influencing factor among them.

V. DROUGHT AND EXCESSIVE RAIN ASSOCIATED WITH THE MIDDLE AND LOWER REACHES OF THE YANGTZE RIVER

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(A line and a half illegible)...Precipitation data still use average monthly data for the 30 years from 1951-1980. The first problem met with here is how to precisely determine whether the April - September precipitation for the areas in question belongs to the scarce rain type or the plentiful rain type. First of all, we solved for the mean square deviation σ. In conjunction with this, we took its values in Fig.5b_2. In this way, Fig.5b_2

was divided into three areas, that is, areas of plentiful rainfall where precipitation deviation values are greater than $+\sigma$, and areas of scarce rainfall where deviation values are smaller than $-\sigma$, as well as normal precipitation areas between $\pm\sigma$. In the figures, it is clearly shown that, in these 30 years, there were four years determined as having plentiful rainfall--1954, 1969, 1970, and 1973. There were three years of scarce rainfall--1966, 1972, and 1978. From this, we see that, in the 30 years from 1951-1980, there were 23 years of normal rainfall in the middle and lower Yangtze-Huai valley, accounting for 77%. Four years of plentiful rain accounted for 13%. Three years of scarce rain accounted for 10%.

The above are years of plentiful and scarce rain determined using April - September precipitation deviation data. However, periods of maximum precipitation are June - August in summer. Now we go a step further in order to see whether or not, as far as years of plentiful rain and years of scarce rain determined by using this type of method are concerned, the summers are actually ones with plentiful rain or scarce rain.

Fig.6 a and b are, respectively, composite precipitation deviation diagrams for the summer months June - August in four years of plentiful rain and three years of scarce rain. From Fig.6a, it is seen that, with regard to summers in years of plentiful rain in the middle and lower reaches of the Yangtze-Huai, China's center of maximum positive precipitation deviation is just in this area. However, the two north and south sides are areas of negative precipitation deviation. From Fig.6b, it is seen that the center of maximum negative composite values for summer precipitation deviation in years of scarce rain is also just in the area of the middle and lower reaches of the Yangtze-Huai. The two north and south sides are zones of positive precipitation deviation. The explanation of this is that the climatic statistical results given here--whether in the April - September rainy season months or in the June - August summer months--in all cases, are reliable. At the same time, we can

also see that years with the appearance of sustained heavy rain and sustained scarce rain in the area of the middle and lower reaches of the Yangtze-Huai have a probability of only 23%.

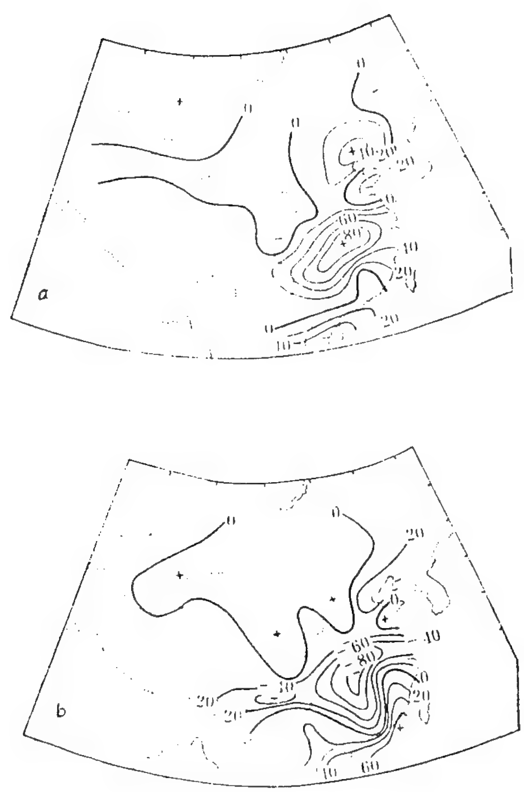

Fig.6 Composite Diagram of Summer Precipitation Deviation from June - August in Years of Plentiful Rain (a--1954, 1969, 1970, 1973) and Years of Scarce Rain (b--1966, 1972, 1978) (Unit: mm)

When heavy rain and scarce rain appear in summer in the area of the middle and lower reaches of the Yangtze-Huai, what characteristics do the area in question and surrounding atmospheric circulation systems have? Fig.7a and 7b are, respectively, 850hPa flow line diagrams from March to July in 1969 (heavy rain year) and 1978 (scarce rain year) (March and July diagrams omitted). Comparing flow fields for June and July in 1969 and 1978, in the case of the June-July period in 1969, the location of West Pacific subtropical high pressure is shifted to the west and south compared to the same period in 1978. The position at which air flows diverging from Australian high pressure cross the equator is also shifted west compared to the same period in 1978. In this way, in June and July of 1969, this branch of air flow crossing the equator and the southwest monsoon combined to form a branch of southwest air flow associated with a relatively large latitude range. The mixing zone of northerly winds and southerly winds was in the vicinity of 30°N. It was advantageous for the formation of a rain zone in the area of the middle and lower Yangtze-Huai. However, in June and July 1978, this transequatorial air flow and the southwest monsoon combined to form a southerly air flow associated with a relatively large range of longitude, causing the mixing zone of warm and cold air to also be relatively toward the north--in the vicinity of approximately 35°N. The area of the middle and lower reaches of the Yangtze-Huai was located under the control of southerly winds. Rain zones were pushed north to the Huai River valley and the surrounding area.

At the same time, from Fig.7, it is seen that, from March to July 1969, the location of West Pacific subtropical high pressure continued to move to the west and south compared to the same period in 1978. Moreover, in 1969, the period of air currents crossing the equator, diverging out from Australian high pressure (May) was earlier than 1978 (April).

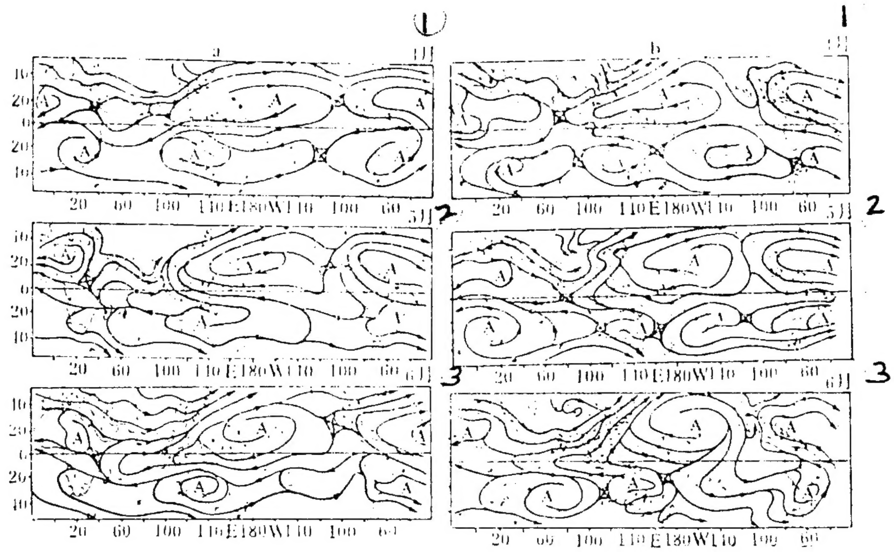

Fig.7 April to June 850hPa Flow Line Diagrams for 1969 (a) and 1978 (b)

Key: (1) April (2) May (3) June

VI. SUMMARY

(1) In the East Asian, South Asian, and Southeast Asian areas, from April to September, distributions of areas of heavy rains above 200mm tend to show a southwest-northeast direction. It and the direction of advance of the southwest monsoon are closely in line. In the middle of this belt of heavy rain, there are roughly three different types of precipitation, that is, the East Asian heavy rain area closely related principally to the seasonal development of East Asian circulation, the relatively large area of heavy rain in a belt from the Bay of Bengal as far as Southeast Asia--receiving influences from tropical convergence belts and terrain--as well as the Indian west coastal area of

heavy rain principally related to influences associated with southwest monsoon systems and terrain.

(2) Ten day precipitation amounts for China's Yangtze-Huai valley--from July to September--harbor quasi periodic oscillation phenomena with periods of approximately 20 days. Moreover, great disparities between the north and south slopes of the Qinghai-Tibet plateau as well as precipitation associated with China's northwest region are related to differences in vertical air flows above them and moisture supplies.

(3) When El Nino appears, the South China area easily shows the appearance of plentiful rain phenomena. However, the Central China area easily shows the appearance of scarce rain phenomena. As far as these two zones are concerned, summer precipitation and El Nino phenomena possess an inverse relationship. North China area summer precipitation and El Nino phenomena are not strongly related.

(4) On the basis of precipitation data for the 30 years from 1951-1980, the probability of the area of the Yangtze-Huai middle and lower reaches producing sustained plentiful rain and sustained scarce rain is only 23%. Precipitation in most years is normal. Speaking, then, in terms of factors influencing summer drought and excessive rain associated with the area of the Yangtze middle and lower reaches, southwest monsoons, transequatorial air flows originating in Australia, West Pacific subtropical high pressure, and northern cold air--as well as their mutual interactions are factors which should be considered in medium and long term precipitation forecasts for this area.

[1] 郭其蕴等，1981，近三十年我国夏季风盛行期降水的分析，地理学报，2 期.

[2] 张家诚等，1985，中国气候，上海科学出版社.

[3] Newell R. E. et al., 1972, The general circulation of the tropical atmosphere and Interactions with extratropical latitudes, Vol. 1—2. The General Circulation of Tropical Atmosphere.

[4] Atkinson, G.D. 1971, Forecaster's Guide to Tropical Meteorology, Air weather service (MAC), united states Air Force.

[5] 竺可桢，1979，中国气候区域论，竺可桢文集，科学出版社.

[6] Kamage, C. S. 1971, Monsoon Meteorology. Academic Press.

[7] 中科院地球物理研究所，1966，西南季风和热带辐合带，东南亚和南亚的大气环流和天气，科学出版社.

[8] 陶诗言等，1958，东亚的梅雨期与亚洲上空大气环流季节变化的关系，气象学报，Vol. 29, No. 2, p. 119—133.

[9] 叶笃正等，1958，在六月和十月大气环流的突变现象，气象学报，Vol. 29, No. 4, p.249—263.

[10] 徐群，1965，近八十年长江中下游的梅雨，气象学报，Vol. 35, No. 4, p. 507—518.

[11] 陈烈庭，1977，东太平洋赤道地区海水温度异常对热带大气环流及我国汛期降水的影响，大气科学，第 1 期，p.1—12.

[12] 大气物理所长期天气预报组，1978，冬季太平洋海水温度异常对我国汛期降水的影响，中科院大气物理所集刊，第 6 号，科学出版社.

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